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Natu J. Patel

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of C. Earl Woolfork	:	
	:	
Serial No. 10/648,012	:	Group Art Unit: 2615
	:	
Confirm. No.: 3337	:	Examiner: Andrew C. Flanders
	:	
Filed: August 26, 2003	:	

For: WIRELESS DIGITAL AUDIO MUSIC SYSTEM

DECLARATION OF APPLICANT REGARDING LIMITED BATTERY LIFE UNDER 35 USC Section 132

I, C. Earl Woolfork, being duly sworn, depose and declare as follows:

1. I am the Inventor of the above referenced patent application ("Application"). I have personal knowledge of the following matter and if asked to testify, could and would testify competently, thereto.

2. Daphne Burton, my then attorney, conducted the interview with Examiner Flanders and Supervisory Patent Examiner Tran (collectively "Examiners") on June 13, 2006 regarding the pending office action dated May 17, 2006. I participated in that interview.

3. During the interview, among other things, we discussed U.S. Patent No. 5,771,441 issued to Altstatt ("Alstatt" or "'the 441 Patent") and U.S. Patent No. 5,946,343 issued to Schotz ("Schotz" or "'the 343 Patent").

4. Examiners requested that I submit evidence in an affidavit under 35 USC Section 132 explaining as to why the combination of Altstatt in view of Schotz is non-operative due to limited battery life.

5. I am hereby submitting this affidavit and all the supporting documentation to the Examiners for their consideration.

6. Altstatt's invention is based on an analog technology and is operated by a battery. Altstatt recites that the maximum value of V is fixed by the battery voltage of 1.5 or possibly 3 volts (Column 8, lines 22-24).

7. Schotz' invention is based on digital technology. Schotz's digital wireless speaker system requires 120VAC at 60Hz. Schotz further states that "[b]oth the transmitter 22 and the receiver 24 have respective power circuits (not shown) that convert input power (e.g., 120VAC at 60 Hz) into proper voltage levels for appropriate transmitter and receiver operation." Please refer to Column 14, lines 1-4.

8. Exhibit A, attached hereto, lists the commercially available Integrated Chip components ("IC Components") that both Altstatt and Schotz identify in their respective designs. Datasheets identifying electrical current requirements to operate the IC Components are included in Exhibit B.

9. Alstatt cannot be combined with Schotz. However, even assuming such a combination is possible, the Altstatt's battery powered analog headphone system will suffer from a significantly reduced playtime due to the power consumption of Schotz's numerous integrated circuit components, as articulated in the calculation spreadsheet attached hereto as Exhibit C.

10. The "playtime" is defined as the time the invention can be operated continuously before the battery must be changed or recharged. The playtime calculation consists of simple unit conversions as defined in chapter one, problem 1.5 and solution set of well known Theodore S. Rappaport's Wireless Communications Principles & Practice textbook. The relevant pages from the textbook are attached herewith as Exhibit D.

According to Exhibit D, the formula for the playtime calculation is:

{((60minutes/1hour) x BmA-h)/[(60 minutes/hour x 24 hour/day)(sum of IC currents in mA)]} x (24hour/day)

where B is the battery current capacity.

11. As shown in Exhibit C, Altstatt's portable invention will yield a playtime greater than 10 hours when operated with a small battery having a current capacity of 50mA-h (50 milliamp-hours).

12. If we were to hypothetically apply the same 50mA-h battery capacity to operate Schotz's invention, Exhibit C further shows that the frequency hopping spread spectrum ("FHSS") system will operate for approximately six minutes, and the direct sequence spread spectrum ("DSSS") system will operate for approximately eleven

minutes before requiring a new battery or a recharged battery. Please note that the FHSS and DSSS system operations are constrained to the lowest device (transmitter or receiver) operation time.

Respectfully Submitted,

Date: 4/14/06

By: C. Earl Woolfork

EXHIBIT A

US Patent Number:5,771,441 Issued to Altstatt

Number	Component Description	Reference
1	Transmitter,BA1404	column 5, lines 34-37
2	Receiver,TA7766AF	column 8, lines 54-58
3	Receiver,TA7792F	column 8, lines 54-58

US Patent Number:5,946,343 Issued to Schotz

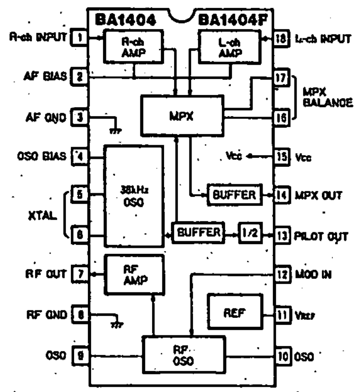
1	Digital Signal Processor,DSP56002	column 14, lines 49-50
2	A/D converter,SAA7360	column 7, lines 11-12
3	Stereo Filter MPEG,SAA2520	column 14, lines 47-48
4	MPEG,SAA2521	column 14, lines 47-48
5	Modulator,RF2422	column 10, lines 17-18
6	Power Amplifier,TQ9132	column 10, lines 31-32
7	Phase Locked Loop,MC12210	column 10, lines 49-50
8	Voltage Controlled Oscillator,SMV2500	column 14, lines 51-53
9	Low Noise Amplifier,MGA86576	column 11, lines 16-18
10	Digital Interface Transmitter,CS8402	column 11, lines 31-33
11	Digital to Analog Converter,TDA1305T	column 13, lines 57-59
12	Clock Recovery & Timing,TRU-050	column 12, lines 28-29
13	Demodulator,RF2703	column 12, lines 13-15
14	Microprocessor,PIC16C55	column 6, lines 63-66
15	DSSS Transmitter,CYLINK SSTX	column 16, lines 62-64
16	DSSS Receiver,CYLINK Part#SPECTRE	column 18, lines 4-5
17	Mixer,IAM81008	column 11, lines 16-18
18	Channel Encoder/Decoder,SRT241203	column 9, lines 25-26
19	Interleaver/De-interleaver,SRT-24INT	column 9, lines 50-52
20	Optical Digital Receiver,HK-3131-01	column 7, lines 40-43
21	Optical Digital Transmitter,HK-3131-03	column 13, lines 15-17
22	Voltage Controlled Oscillator,M2 D300	column 8, lines 49-50

EXHIBIT B

US Patent Number:5,771,441 Issued to Altstatt

Item Number 1: Transmitter, BA1404

● ブロックダイアグラム／Block Diagram T-77-05-05



● 絶対最大定格／Absolute Maximum Ratings (Ta=25℃)

Parameter	Symbol	Limits	Unit
電源電圧	V_{CC}	2.5	V
許容損失	P_d	500*	mW
動作温度範囲	Topr	−25～75	℃
保存温度範囲	Tstg	−50～125	℃

*Ta=25℃以上で使用する場合は,1℃につき5mWを減じる

● 推奨動作条件／Recommended Operating Conditions (Ta=25℃)

Parameter	Symbol	Min.	Typ.	Max.	Unit
電源電圧	V_{CC}	1	1.25	2.	V

● 電気的特性／Electrical Characteristics (Ta=25℃, V_{CC}=1.25V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
無信号時電流	I_Q	0.5	3	5	mA	—
入力インピーダンス	Z_{IN}	360	540	720	Ω	f_{IN}=1kHz
入力利得	G_V	30	37	—	dB	V_{IN}=0.5mV
チャンネルバランス	CB	—	—	2	dB	V_{IN}=0.5mV
MPX最大出力電圧	V_{OM}	200	—	—	mV_{P-P}	THD≦3%
MPX 38kHzもれ	V_{OO}	—	1	—	mV	無信号時
パイロット出力電圧	V_{OP}	460	580	—	mV_{P-P}	無負荷時
チャンネルセパレーション	Sep	25	45	—	dB	基準復調器にて
入力換算雑音電圧	V_{NIN}	—	1	—	μV_{rms}	38kHz停止時 IHF—A
RF部最大出力電圧	V_{OSO}	350	600	—	mV_{rms}	—

オーディオ用 高周波信号処理系

US Patent Number:5,771,441 Issued to Altstatt

Item Number 2: Receiver, TA 7766AF

ELECTRICAL CHARACTERISTICS (Unless otherwise specified, $Ta = 25°C$, $V_{CC} = 1.5V$, $f_m = 1kHz$)

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Supply Current		I_{CC}	—	At lamp off		—	0.8	1.6	mA
Input Resistance		R_{IN}	—			—	36	—	kΩ
Output Resistance		R_{OUT}	—			—	15	—	kΩ
Max. Composite Signal Input Voltage		V_{in} (MAX) (STEREO)	—	L+R=90%, P=10%, THD=5% $SW_1 \rightarrow R_{LED} = 50k\Omega$ $SW_5 \rightarrow LPF$ ON		—	250	—	mV_{rms}
Separation		Sep	—	$L+R = 90mV_{rms}$ $P = 10mV_{rms}$ $SW_1 \rightarrow R_{LED} = 50k\Omega$ $SW_5 \rightarrow LPF$ ON	$f_m = 100Hz$	—	30	—	dB
					$f_m = 1kHz$	22	35	—	
					$f_m = 10kHz$	—	30	—	
Total Harmonic Distortion	Monaural	THD (MONAURAL)	—	$V_{in} = 100mV_{rms}$ $SW_1 \rightarrow R_{LED} = 500\Omega$		—	0.2	1.5	%
	Stereo	THD (STEREO)		$L+R = 90mV_{rms}$, $P = 10mV_{rms}$ $SW_1 \rightarrow R_{LED} = 50k\Omega$ $SW_5 \rightarrow LPF$ ON		—	0.4	—	
Voltage Gain		G_V	—	$V_{in} = 100mV_{rms}$ $SW_1 \rightarrow R_{LED} = 500\Omega$		−4	−2	1	dB
Channel Balance		CB	—	$V_{in} = 100mV_{rms}$ $SW_1 \rightarrow R_{LED} = 500\Omega$		—	0	2.0	dB
Lamp ON Sensitivity		V_L (ON)	—	Pilot input	$SW_1 \rightarrow R_{LED} = 50k\Omega$	—	—	5	mV_{rms}
Lamp OFF Sensitivity		V_L (OFF)			$SW_1 \rightarrow R_{LED} = 500\Omega$	7	—	—	
Stereo Lamp Hysteresis		V_H	—	to turn-off from turn-on		—	3	—	mV_{rms}
Capture Range		CR	—	$P = 10mV_{rms}$		—	±3	—	%
Carrier Leak (Note)	19kHz	CL	—	$L+R = 90mV_{rms}$ $P = 10mV_{rms}$ $SW_1 \rightarrow R_{LED} = 50k\Omega$		—	30	—	dB
	38kHz					—	50	—	
SCA Rejection Ratio		SCA Rej	—	$P = 10mV_{rms}$, $L+R = 90mV_{rms}$ $SCA = 10mV_{rms}$, $f_{SCA} = 67kHz$ $SW_1 \rightarrow R_{LED} = 50k\Omega$		—	70	—	dB
Signal to Noise Ratio		S/N	—	$V_{in} = 100mV_{rms}$, $R_g = 620\Omega$ $SW_1 \rightarrow R_{LED} = 500\Omega$		—	65	—	dB

(Note) Carrier leak of 38kHz is only carrier.

US Patent Number:5,771,441 Issued to Altstatt

Item Number 3: Receiver, TA 7792F

MAXIMUM RATINGS ($Ta = 25°C$)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Supply Voltage		V_{CC}	5	V
Power Dissipation	TA7792P	P_D (Note)	750	mW
	TA7792F		350	
Operating Temperature		T_{opr}	−25~75	°C
Storage Temperature		T_{stg}	−55~150	°C

(Note) Derated above $Ta = 25°C$ in the proportion of 6mW/°C for TA7792P, and of 2.8mW/°C for TA7792F.

ELECTRICAL CHARACTERISTICS
Unless otherwise specified, $Ta = 25°C$, $V_{CC} = 1.5V$
FM : $V_{in} = 60dB\mu V$ EMF, $f = 83MHz$, $f_m = 1kHz$, $\Delta f = \pm 22.5kHz$
AM : $V_{in} = 60dB\mu V$ EMF, $f = 1MHz$, $f_m = 1kHz$, MOD = 30%

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current		I_{CC} (FM)	1	$V_{in} = 0$	—	4.0	5.2	mA
		I_{CC} (AM)	1	$V_{in} = 0$	—	1.2	1.8	
FM	Input Limiting Voltage	V_{in} (lim)	1	−3dB limiting	—	10	16	dBμV EMF
	Total Harmonic Distortion	THD (FM)	1		—	0.25	—	%
	Signal To Noise Ratio	S/N (FM)	1		—	62	—	dB
	Quiescent Sensitivity	Q_S	1	S/N = 30dB	—	12	—	dBμV EMF
	AM Rejection Ratio	AMR	1	MOD = 30%	—	30	—	dB
	Oscillator Voltage	V_{osc}	2	f = 60MHz	53	90	135	mV_{rms}
	Oscillator Stop Supply Voltage	V_{stop} (FM)	1	$V_{in} < -20dB\mu V$ EMF	—	0.85	0.95	V
	Recovered Output Voltage	V_{OD} (FM)	1		28	45	60	mV_{rms}
AM	Voltage Gain	G_V	1	$V_{in} = 30dB\mu V$ EMF	14	25	50	mV_{rms}
	Recovered Output Voltage	V_{OD} (AM)	1		25	40	60	mV_{rms}
	Total Harmonic Distortion	THD (AM)	1		—	1.5	—	%
	Signal To Noise Ratio	S/N (AM)	1		—	40	—	dB
	Oscillator Stop Supply Voltage	V_{stop} (AM)	1	$V_{in} < -20dB\mu V$ EMF	—	0.85	0.95	V
Output Resistance Pin8	FM	R_o (FM)	1	f = 1kHz	—	1.4	—	kΩ
	AM	R_o (AM)	1	f = 1kHz	—	8	—	

※ V_{in} : Open Display

US Patent Number:5,946,343 Issued to Schotz

Item Number 1: Digital Signal Processor, DSP56002

DC ELECTRICAL CHARACTERISTICS

Table 2-3 DC Electrical Characteristics

Characteristics	Symbol	Min	Typ	Max	Units
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Input High Voltage					
• EXTAL	V_{IHC}	4.0	—	V_{CC}	V
• $\overline{RESET}$	V_{IHR}	2.5	—	V_{CC}	V
• MODA, MODB, MODC	V_{IHM}	3.5	—	V_{CC}	V
• All other inputs	V_{IH}	2.0	—	V_{CC}	V
Input Low Voltage					
• EXTAL	V_{ILC}	-0.5	—	0.6	V
• MODA, MODB, MODC	V_{ILM}	-0.5	—	2.0	V
• All other inputs	V_{IL}	-0.5	—	0.8	V
Input Leakage Current EXTAL, $\overline{RESET}$, MODA/$\overline{IRQA}$, MODB/$\overline{IRQB}$, MODC/$\overline{NMI}$, DR, BR, WT, CKP, PINIT, SCLK, SCKR, MCCLK, D20N	I_{IN}	-1	—	1	µA
Tristate (Off-state) Input Current (@ 2.4 V/0.4 V)	I_{TSI}	-10	—	10	µA
Output High Voltage (I_{OH} = -0.4 mA)	V_{OH}	2.4	—	—	V
Output Low Voltage (I_{OL} = 3.0 mA) $\overline{HREQ}$ I_{OL} = 6.7 mA, TXD I_{OL} = 6.7 mA	V_{OL}	—	—	0.4	V
Internal Supply Current at 40 MHz[1]	I_{CCI}	—	80	105	mA
• In Wait mode[2]	I_{CCW}	—	12	20	mA
• In Stop mode[2]	I_{CCS}	—	2	95	µA
Internal Supply Current at 66 MHz[1]	I_{CCI}	—	95	130	mA
• In Wait mode[2]	I_{CCW}	—	15	25	mA
• In Stop mode[2]	I_{CCS}	—	2	95	µA
Internal Supply Current at 80 MHz[1]	I_{CCI}	—	115	160	mA
• In Wait mode[2]	I_{CCW}	—	18	30	mA
• In Stop mode[2]	I_{CCS}	—	2	95	µA
PLL Supply Current[3]					
• 40 MHz		—	1.0	1.5	mA
• 66 MHz		—	1.1	1.5	mA
• 80 MHz		—	1.2	1.8	mA
CKOUT Supply Current[4]					
• 40 MHz		—	14	20	mA
• 66 MHz		—	28	35	mA
• 80 MHz		—	34	42	mA
Input Capacitance[5]	C_{IN}	—	10	—	pF

Notes:
1. Section 4 Design Considerations describes how to calculate the external supply current.
2. In order to obtain these results all inputs must be terminated (i.e., not allowed to float).
3. Values are given for PLL enabled.
4. Values are given for CKOUT enabled.
5. Periodically sampled and not 100% tested

US Patent Number:5,946,343 Issued to Schotz

Item Number 2: A/D Converter, SAA7360

Bitstream conversion ADC for digital audio systems

SAA7360

Table 1 Output data formats

ODF2	ODF1	MODE
0	0	test
0	1	format 1
1	0	format 2
1	1	I²S

Reset

When pin $\overline{RESET}$ is held LOW the data outputs are set to zero. The $\overline{RESET}$ pin operates as a Schmitt trigger, enabling a power-on reset function by using an external RC circuit.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DDA}	analog supply voltage	note 1	−0.5	+6.5	V
V_I	DC input voltage		−0.5	+6.5	V
I_{IK}	DC input diode current		–	±20	mA
V_O	DC output voltage		−0.5	V_{DD} + 0.5	V
I_O	DC output source or sink current		–	±20	mA
I_{DD} or I_{SS}	total DC V_{DD} or V_{SS} current		–	±0.5	A
T_{amb}	operating ambient temperature		−40	+85	°C
T_{stg}	storage temperature		−65	+150	°C
V_{es}	electrostatic handling	note 2	−2000	+2000	V
		note 3	−200	+200	V

Notes

1. All V_{DD} and V_{SS} pins must be externally connected to the same power supply.
2. Equivalent to discharging a 100 pF capacitor via a 1.5 kΩ series resistor with a rise time of 15 ns.
3. Equivalent to discharging a 200 pF capacitor via a 2.5 μH series inductor.

CHARACTERISTICS

V_{DD} = 5 V; T_{amb} = 25 °C; f_{sys} = 256f_s; f_s = 44.1 kHz unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supplies						
V_{DDA}	analog supply voltage		4.5	5.0	5.5	V
I_{DDA}	analog supply current		–	43	–	mA
V_{DDD}	digital supply voltage		4.5	5.0	5.5	V
I_{DDD}	digital supply current		–	50	–	mA
P_{tot}	total power consumption		–	465	–	mW

US Patent Number:5,946,343 Issued to Schotz

Item Number 3: Stereo Filter MPEG, SAA2520

Stereo filter and codec for MPEG layer 1 audio applications

SAA2520

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DD}	supply voltage		−0.5	6.5	V
V_I	input voltage	note 1	−0.5	V_{DD} + 0.5	V
I_{SS}	supply current from V_{SS}		−	100	mA
I_{DD}	supply current in V_{DD}		−	100	mA
I_I	input current		−10	10	mA
I_O	output current		−20	20	mA
P_{tot}	total power dissipation		−	550	mW
T_{stg}	storage temperature range		−65	150	°C
T_{amb}	operating ambient temperature range		−40	85	°C
V_{es1}	electrostatic handling	note 2	−1500	1500	V
V_{es2}	electrostatic handling	note 3	−70	70	V

Notes

1. Input voltage should not exceed 6.5 V unless otherwise specified
2. Equivalent to discharging a 100 pF capacitor through a 1.5 kΩ series resistor
3. Equivalent to discharging a 200 pF capacitor through a 0 Ω series resistor.

DC CHARACTERISTICS

T_{amb} = −40 to 85 °C; V_{DD} = 3.8 to 5.5 V unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply						
V_{DD}	supply voltage range		3.8	5.0	5.5	V
I_{DD}	operating current	V_{DD} = 5 V (note 1)	−	82	110	mA
I_{DD}	operating current	V_{DD} = 3.8 V (note 1)	−	58	80	mA
Inputs URDA, SBDIR, SBEF, LTCLK, LTCNT0, LTCNT1, X22IN, X24IN						
V_{IH}	HIGH level input voltage		0.7V_{DD}	−	−	V
V_{IL}	LOW level input voltage		−	−	0.3V_{DD}	V
$-I_I$	input current	V_I = 0 V; T_{amb} = 25 °C	−	−	10	µA
$+I_I$	input current	V_I = 5.5 V; T_{amb} = 25 °C	−	−	10	µA
Inputs PWRDWN, LTENA						
V_{IH}	HIGH level input voltage		0.7V_{DD}	−	−	V
V_{IL}	LOW level input voltage		−	−	0.3V_{DD}	V
$+I_I$	input current	V_I = V_{DD}; T_{amb} = 25 °C	40	−	250	µA

US Patent Number:5,946,343 Issued to Schotz

Item Number 4: MPEG, SAA2521

Masking threshold processor for MPEG layer 1 audio compression applications | SAA2521

DC CHARACTERISTICS

V_{DD} = 3.6 to 5.5 V; T_{amb} = −40 to 85 °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply						
V_{DD}	supply voltage range		3.6	5	5.5	V
I_{DD}	operating current	V_{DD} = 3.6 V	–	15	30	mA
I_{DD}	operating current	V_{DD} = 5 V	–	25	50	mA
$I_{standby}$	stand-by current	in power-down mode	–	100	–	µA
Inputs						
V_{IL}	LOW level input voltage		0	–	0.3 V_{DD}	V
V_{IH}	HIGH level input voltage		0.7 V_{DD}	–	V_{DD}	V
I_I	input current		–	–	10	µA
Outputs						
V_{OL}	LOW level output voltage	note 1	–	–	0.4	V
V_{OH}	HIGH level output voltage	note 1	V_{DD} − 0.5	–	–	V
3-state outputs						
I_{oz}	OFF state current	V_I = 0 to 5.5 V	–	–	10	µA

Note

1. Maximum load current for LTDATA, LTCNTIC, LTCNTJC, LTENC, LTCLKC, TEST1, TEST2, FDAC, FDAF = 2 mA; for LTDATAC = 3 mA.

US Patent Number:5,946,343 Issued to Schotz

Item Number 5: Modulator, RF2422

RF2422

5

MODULATORS AND UPCONVERTERS

Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	-0.5 to +7.5	V_{CC}
Input LO and RF Levels	+10	dBm
Operating Ambient Temperature	-40 to +85	°C
Storage Temperature	-40 to +150	°C

Caution! ESD sensitive device.

[illegible]

Parameter	Specification Min.	Specification Typ.	Specification Max.	Unit	Condition
Carrier Input					T=25°C, V_{CC}=5V
Frequency Range	800		2500	MHz	
Power Level	-8		+6	dBm	
Input VSWR		3:1			At 900MHz
		1.8:1			At 1500MHz
		1.2:1			At 2500MHz
Modulation Input					
Frequency Range	DC		250	MHz	
Reference Voltage (VREF)	2.0	3.0		V	
Maximum Modulation (ISO)			VREF±1.0	V	
Gain Asymmetry		0.2		dB	
Quadrature Phase Error		3		°	
Input Resistance		30		kΩ	
Input Bias Current			40	μA	
RF Output					LO=2GHz and -5dBm, MO=2.0Vpp, SSB
Output Power	-3		+3	dBm	
Output Impedance		50		Ω	
Output VSWR		3.5:1			At 900MHz
		1.2:1			At 2000MHz
		1.15:1			At 2500MHz
Harmonic Output	-40	-25		dBc	
Sideband Suppression	25	55		dB	
Carrier Suppression	30	35		dB	
IM3 Suppression	30	35		dB	Intermodulation of the carrier and the desired RF signal
	25	30		dB	Intermodulation of baseband signals
Broadband Noise Floor					At 20MHz offset, V_{CC}=5V, Tied to VREF (ISO, QSIO, IREF and QREF)
		-145		dBm/Hz	At 850MHz
		-152		dBm/Hz	At 1500MHz
Power Down					
Turn On/Off Time			100	ns	
PD Input Resistance	50			kΩ	
Power Control "ON"			2.5	V	Threshold voltage
Power Control "OFF"	1.0	1.2		V	Threshold voltage
Power Supply					
Voltage		5		V	Specifications
	4.5		6.0	V	Operating limits
Current		45	50	mA	Operating
			25	μA	Power Down

US Patent Number:5,946,343 Issued to Schotz

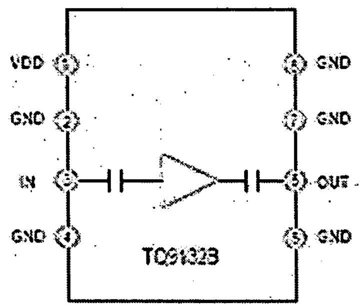
Item Number 6: Power Amplifier, TQ9132

TriQuint SEMICONDUCTOR
WIRELESS COMMUNICATIONS DIVISION

TQ9132B

DATA SHEET

3V Cellular TDMA/AMPS Power Amplifier IC



Product Description

The TQ9132B amplifier is an 800-2500 MHz amplifier capable of providing moderate output power (50 mW) for a wide variety of transmit and receive applications. The amplifier's input and output are matched to 50 Ω with internal circuitry, simplifying interfaces to 50 Ω systems. In addition, DC blocking capacitors are included on chip, permitting direct connections to the input and output. Its 8-pin surface mount package and low cost are well suited to many wireless communications applications.

Electrical Specifications[1]

Parameter	Min	Typ	Max	Units
Gain	13.5	15		dB
Output 1 dB Gain Compression	15.5	17		dBm
Input Return Loss		12		dB
Output Return Loss		12		dB
DC Supply Current		85	100	mA

Note 1: Test Conditions: Vdd = 3.0 V, Freq. = 2500 MHz, T = 25° C.
Note 2: Minimum values 100% production tested

Features

- Single 3V-5V supply
- Wide frequency range
- +17 dBm output power
- Input and output matched to 50 Ω
- SO-8 surface mount plastic package

Applications

- Power Amplifier drivers
- PCN Medium-power amplifiers
- Medium-power WLANs
- CDPD Modems
- Base Station receivers

For additional information and latest specifications, see our website: www.triquint.com 1

US Patent Number:5,946,343 Issued to Schotz

Item Number 7: Phase Locked Loop, MC12210

ELECTRICAL CHARACTERISTICS (V_{CC} = 2.7 to 5.5 V; T_A = –40 to +85°C, unless otherwise noted)

Parameter	Symbol	Min	Typ	Max	Unit	Condition
Supply Current for V_{CC}	I_{CC}	–	2.5	3.0	mA	Note 1
		–	10.2	13.0		Note 2
Supply Current for V_P	I_P	–	0.7	1.1	mA	Note 3
		–	0.8	1.3		Note 4
Operating Frequency f_{IN} max / f_{IN} min	F_{IN}	2500 –	– –	– 500	MHz	Note 5
Operating Frequency (OSCin)	F_{OSC}	–	12	30	MHz	Crystal Mode
		–	–	40	MHz	External Reference Mode
Input Sensitivity f_{IN}	V_{IN}	200	–	1000	mVpp	
OSCin	V_{OSC}	500	–	2200	mVpp	
Input HIGH Voltage CLK, DATA, LE, FC	V_{IH}	0.7 V_{CC}	–	–	V	
Input LOW Voltage CLK, DATA, LE, FC	V_{IL}	–	–	0.3 V_{CC}	V	V_{CC} = 5.5 V
Input HIGH Current (DATA and CLK)	I_{IH}	–	1.0	2.0	µA	V_{CC} = 5.5 V
Input LOW Current (DATA and CLK)	I_{IL}	–10	–9.0	–	µA	V_{CC} = 5.5 V
Input Current (OSCin)	I_{OSC}	– –	150 –310	– –	µA	OSCin = V_{CC} OSCin = V_{CC} – 2.2 V
Input HIGH Current (LE and FC)	I_{IH}	–	1.0	2.0	µA	
Input LOW Current (LE and FC)	I_{IL}	–75	–40	–	µA	
Charge Pump Output Current Do and DSW	I_{Source}[6]	–2.8	–2.0	–1.4	mA	V_{Do} = V_P/2, V_P = 2.7 V
	I_{Sink}[6]	+1.4	+2.0	+2.8		V_{DSW} = V_P/2, V_P = 2.7 V
	I_{Hi-Z}	–15	–	+15	nA	0.5 < V_{Do} < V_P – 0.5 0.5 < V_{DSW} < V_P – 0.5
Output HIGH Voltage (LD, φR, φP, f_{OUT})	V_{OH}	4.4	–	–	V	V_{CC} = 5.0 V
		2.4	–	–	V	V_{CC} = 3.0 V
Output LOW Voltage (LD, φR, φP, f_{OUT})	V_{OL}	–	–	0.4	V	V_{CC} = 5.0 V
		–	–	0.4	V	V_{CC} = 3.0 V
Output HIGH Current (LD, φR, φP, f_{OUT})	I_{OH}	–1.0	–	–	mA	
Output LOW Current (LD, φR, φP, f_{OUT})	I_{OL}	1.0	–	–	mA	

1. V_{CC} = 3.3 V, all outputs open.
2. V_{CC} = 5.5 V, all outputs open.
3. V_P = 3.3 V, all outputs open.
4. V_P = 6.0 V, all outputs open.
5. AC coupling, F_{IN} measured with a 1000 pF capacitor.
6. Source current flows out of the pin and sink current flows into the pin.

Figure 8. Typical External Charge Pump Circuit

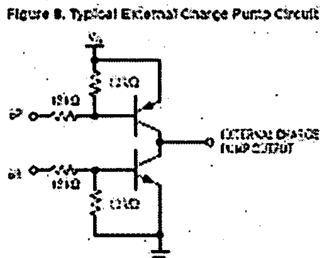
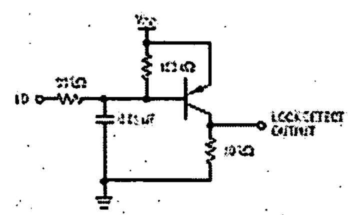


Figure 9. Typical Lock Detect Circuit



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Item Number 8: Voltage Controlled Oscillator, SMV2500

Z-Communications, Inc.
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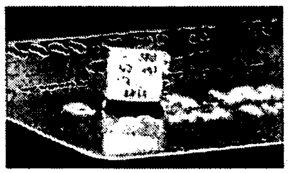
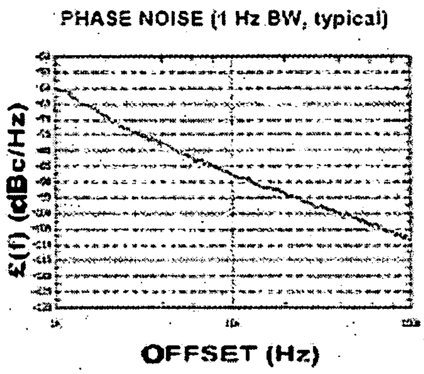
SMV2500L
VOLTAGE CONTROLLED OSCILLATOR
Rev B





FEATURES

- Frequency Range: 2400 - 2484 MHz
- Tuning Voltage: 0-3 Vdc
- SUB-L - Style Package

APPLICATIONS

- Personal Communications Systems
- WLAN
- Portable Radios

PERFORMANCE SPECIFICATIONS	VALUE	UNITS
Oscillation Frequency Range	2400 - 2484	MHz
Phase Noise @ 10 kHz offset (1 Hz BW, typ.)	-87	dBc/Hz
Harmonic Suppression (2nd, typ.)	-20	dBc
Tuning Voltage	0-3	Vdc
Tuning Sensitivity (avg.)	105	MHz/V
Power Output	9.25±2.75	dBm
Load Impedance	50	Ω
Input Capacitance (max.)	50	pF
Pushing	<30	MHz/V
Pulling (14 dB Return Loss, Any Phase)	<25	MHz
Operating Temperature Range	-40 to 85	°C
Package Style	SUB-L	
POWER SUPPLY REQUIREMENTS		
Supply Voltage (Vcc, nom.)	3	Vdc
Supply Current (Icc, typ.)	19	mA

All specifications are typical unless otherwise noted and subject to change without notice.

APPLICATION NOTES

- AN-100/1 : Mounting and Grounding of VCOs
- AN-102 : Proper Output Loading of VCOs
- AN-107 : How to Solder Z-COMM VCOs

NOTES:

US Patent Number:5,946,343 Issued to Schotz

Item Number 9: Low Noise Amplifier, MBA86576

Absolute Maximum Ratings

Symbol	Parameter	Units	Absolute Maximum[1]
V_d	Device Voltage, RF output to ground	V	9
V_g	Device Voltage, RF input to ground	V	+0.5 -1.0
P_{in}	CW RF Input Power	dBm	+13
T_{ch}	Channel Temperature	°C	150
T_{STG}	Storage Temperature	°C	-65 to 150

Thermal Resistance[2]: $\theta_{ch\text{-}c} = 110°C/W$

Notes:
1. Operation of this device above any one of these limits may cause permanent damage.
2. $T_C = 25°C$ (T_C is defined to be the temperature at the package pins where contact is made to the circuit board).

MGA-86576 Electrical Specifications, $T_C = 25°C$, $Z_o = 50\ \Omega$, $V_d = 5V$

Symbol	Parameters and Test Conditions		Units	Min.	Typ.	Max.
G_p	Power Gain ($\lvert S_{21}\rvert^2$)	f = 1.5 GHz f = 2.5 GHz f = 4.0 GHz f = 6.0 GHz f = 8.0 GHz	dB	20	21.2 20.7 20.4 19.3 16.4	
NF_{50}	50 Ω Noise Figure	f = 1.5 GHz f = 2.5 GHz f = 4.0 GHz f = 6.0 GHz f = 8.0 GHz	dB		2.2 1.9 2.0 2.3 2.5	2.9
NF_o	Optimum Noise Figure (Input tuned for lowest noise figure)	f = 1.5 GHz f = 2.5 GHz f = 4.0 GHz f = 6.0 GHz f = 8.0 GHz	dB		1.6 1.6 1.6 1.9 2.1	
P_{1dB}	Output Power at 1 dB Gain Compression	f = 1.5 GHz f = 2.5 GHz f = 4.0 GHz f = 6.0 GHz f = 8.0 GHz	dBm		6.4 7.0 6.3 4.3 3.3	
IP_3	Third Order Intercept Point	f = 4.0 GHz	dBm		16.0	
VSWR	Input VSWR	f = 1.5 GHz f = 2.5 GHz f = 4.0 GHz f = 6.0 GHz f = 8.0 GHz			3.2:1 2.8:1 2.2:1 1.4:1 1.2:1	2.6:1
	Output VSWR	f = 1.5 GHz f = 2.5 GHz f = 4.0 GHz f = 6.0 GHz f = 8.0 GHz			2.2:1 2.1:1 1.5:1 1.4:1 1.2:1	
I_d	Device Current		mA	9	16	22

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Item Number 10: Digital Interface Transmitter, CS8402

ABSOLUTE MAXIMUM RATINGS (GND = 0V, all voltages with respect to ground.)

Parameter	Symbol	Min	Max	Units
DC Power Supply	VD+		6.0	V
Input Current, Any Pin Except Supply Note 1	I_{in}	-	±10	mA
Digital Input Voltage	V_{IND}	-0.3	VD+	V
Ambient Operating Temperature (power applied)	T_A	-55	125	°C
Storage Temperature	T_{stg}	-65	150	°C

Notes: 1. Transient currents of up to 100 mA will not cause SCR latch-up.

WARNING: Operation at or beyond these limits may result in permanent damage to the device. Normal operation is not guaranteed at these extremes.

RECOMMENDED OPERATING CONDITIONS

(GND = 0V; all voltages with respect to ground)

Parameter	Symbol	Min	Typ	Max	Units
DC Voltage	VD+	4.5	5.0	5.5	V
Supply Current Note 2	I_{CC}		1.5	5	mA
Ambient Operating Temperature: CS8401/2A-CP or -CS Note 3	T_A	0	25	70	°C
CS8401/2A-IP or -IS		-40		85	°C
Power Consumption Note 2	P_D		7.5	25	mW

Notes: 2. Drivers open (unloaded). The majority of power is used in the load connected to the drivers.
3. The "-CP" and "-CS" parts are specified to operate over 0 to 70 °C but are tested at 25 °C only. The "-IP" and "-IS" parts are tested over the full -40 to 85 °C temperature range.

DIGITAL CHARACTERISTICS

(T_A = 25 °C for suffixes 'CP' & 'CS', T_A = -40 to 85 °C for 'IP' & 'IS'; VD+ = 5V ± 10%)

Parameter	Symbol	Min	Typ	Max	Units
High-Level Input Voltage	V_{IH}	2.0		V_{DD}+0.3	V
Low-Level Input Voltage	V_{IL}	-0.3		+0.8	V
High-Level Output Voltage (I_O = 200µA)	V_{OH}	V_{DD}-1.0			V
Low-Level Output Voltage (I_O = 3.2mA)	V_{OL}			0.4	V
Input Leakage Current	I_{in}		1.0	10	µA
Master Clock Frequency: CS8401A Note 4	MCK			22	MHz
CS8402A Note 4				7.5	MHz
Master Clock Duty Cycle CS8401/2A		40		60	%

Notes: 4. MCK for the CS8401 must be 128, 192, 256, or 384X the input word rate based on M0 and M1 in control register 2. MCK for the CS8402A must be 128X the input word rate, except in Transparent Mode where MCK is 256X the input word rate.

Specifications are subject to change without notice.

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Item Number 11: Digital to Analog Converter, TDA1305T

Stereo 4fs data input up-sampling filter with bitstream continuous dual DAC (SCC-DAC2)

TDA1305T

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{DDD}	digital supply voltage	note 1	3.4	5.0	5.5	V
V_{DDA}	analog supply voltage	note 1	3.4	5.0	5.5	V
V_{DDO}	operational amplifier supply voltage	note 1	3.4	5.0	5.5	V
I_{DDD}	digital supply current	V_{DDD} = 5 V; at code 0000H	–	30	–	mA
I_{DDA}	analog supply current	V_{DDA} = 5 V; at code 0000H	–	5.5	9	mA
I_{DDO}	operating amplifier supply current	V_{DDO} = 5 V; at code 0000H	–	6.5	9	mA
$V_{FS(rms)}$	full-scale output voltage (RMS value)	V_{DDD} = V_{DDA} = V_{DDO} = 5 V	1.425	1.5	1.575	V
(THD + N)/S	total harmonic distortion plus noise-to-signal ratio	at 0 dB signal level	–	−90	−81	dB
			–	0.003	0.009	%
		at −60 dB signal level	–	−44	−40	dB
			–	0.63	0.1	%
		at −60 dB signal level; A-weighted	–	−46	–	dB
			–	0.5	–	%
S/N	signal-to-noise ratio at bipolar zero	A-weighting; at code 0000H	100	108	–	dB
BR_{ni}	input bit rate at data input	f_s = 48 kHz; normal speed	–	–	3.072	Mbits
BR_{di}	input bit rate at data input	f_s = 48 kHz; double speed	–	–	6.144	Mbits
f_{sys}	system clock frequency		6.4	–	18.432	MHz
TC_{FS}	full scale temperature coefficient at analog outputs (VOL and VOR)		–	$\pm 100 \times 10^{-6}$	–	
T_{amb}	operating ambient temperature		−40	–	+85	°C

Note

1. All V_{DD} and V_{SS} pins must be connected to the same supply.

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Item Number 12: Clock Recovery & Timing, TRU-050

[illegible]

Parameter	Symbol	Min	Max	Unit
Input NRZ Data Rates	[illegible]	0.023	65.536	[illegible]
[illegible] [2]	[illegible]	0.023	32.768	[illegible]
[illegible] Output Frequency				
Output 1	[illegible]	2.0	65.536	[illegible]
Output 2 [2]	[illegible]	2.05	32.768	[illegible]
Supply Voltage [3]	V_{DD}	4.5	5.5	V
Supply Current (V_{DD} = 5.5 V)	I_{DD}	25	63	mA
Output Voltage Levels (V_{DD} = 4.5 V)				
Output Logic High [4]	V_{OH}	2.5		V
Output Logic Low [4]	V_{OL}	-	0.5	V
Transition Times [4]				
Rise Time (0.5 V to 2.5 V)	t_R	0.5	5	ns
Fall Time (2.5 V to 0.5 V)	t_F	0.5	5	ns
Symmetry or Duty Cycle [5]				
Output 1	SYM 1	45	60	%
Output 2	SYM 2	45	55	%
Recovered Clock	[illegible]	49	61	%
Input Data				
Input Logic High	V_{IH}	2.0	-	V
Input Logic Low	V_{IL}	-	0.8	V
[illegible]	[illegible]	50	-	[illegible]
[illegible]	[illegible]	See Figure [illegible]		[illegible]
Loss of Signal Indicator [6]	[illegible]			
Output Logic High	V_{OH}	2.5	-	V
Output Logic Low	V_{OL}	-	0.5	V
[illegible] [7]				
Output 1	[illegible]	-75 ppm	75 ppm	[illegible]
Output 2	[illegible]	-75 ppm	75 ppm	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]

Table 1.

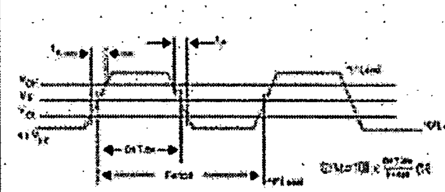

Figure 1.

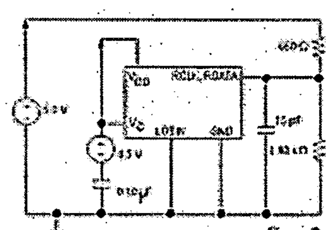

Figure 2.

US Patent Number:5,946,343 Issued to Schotz

Item Number 13: Demodulator, RF2703

RF2703

7

QUADRATURE DEMODULATORS

Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	-0.5 to 7.0	V_{DC}
IF Input Level	500	mV_{pp}
Operating Ambient Temperature	-40 to +85	°C
Storage Temperature	-40 to +150	°C

Caution! ESD sensitive device.

[illegible]

Parameter	Specification Min.	Specification Typ.	Specification Max.	Unit	Condition
Overall					T=25°C, V_{CC}=3.0V, IF=100MHz, LO=200MHz, F_{USB}=500kHz
IF Frequency Range		0.1 to 250		MHz	For IF frequencies below ~2.5MHz, the LO should be a square wave. IF frequencies lower than 100kHz are attainable if the LO is a square wave and sufficiently large DC blocking capacitors are used.
Baseband Frequency Range		DC to 50		MHz	
Input Impedance		1200 ∥ 1pF		Ω	Each input, single-ended
LO					
Frequency					Twice (2x) the IF frequency. For IF frequencies below ~2.5MHz, the LO should be a square wave. IF frequencies lower than 100kHz are attainable if the LO is a square wave and sufficiently large DC blocking capacitors are used.
Level		0.06 to 1		V_{pp}	
Input Impedance		500 ∥ 1pF		Ω	
Demodulator Configuration					F_{IN}=20mVpp, LO=200mVpp, Z_{LOAD}=10kΩ
Output Impedance		50 ∥ 1pF		Ω	Each output, I_{OUT} and Q_{OUT}
Maximum Output		1.4		V_{pp}	Saturated
Voltage Gain		20		dB	V_{CC}=3.0V
	22.5	24	25.1	dB	V_{CC}=5.0V
Noise Figure		24		dB	Single Sideband, IF input of device reactively matched
		35		dB	Single Sideband, 50Ω shunt resistor at IF input
Input Third Order Intercept Point (IP_3)		-22		dBm	V_{CC}=3.0V, IF input of device reactively matched
		-11		dBm	V_{CC}=3.0V, 50Ω shunt resistor at IF input
		-10			V_{CC}=5.0V, IF input of device reactively matched.
		-8		dBm	V_{CC}=5.0V, 50Ω shunt resistor at IF input
		-20		dBm	V_{CC}=5.0V, IF input of device reactively matched, Z_{LOAD}=50Ω.
I/Q Amplitude Balance		0.1	0.5	dB	
Quadrature Phase Error		<±1		°	
DC Output		800		mV	V_{CC}=3.0V, I_{OUT} and Q_{OUT} to GND
	2.0	2.4	2.8	V	V_{CC}=5.0V, I_{OUT} and Q_{OUT} to GND
DC Offset		<10	50	mV	I_{OUT} to Q_{OUT}

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Item Number 13: Demodulator, RF2703 continued

RF2703

Modulator Configuration					IF_{IN}=25mVpp, LO=200mVpp, Z_{LOAD}=1250Ω
Maximum Output		200		mVpp	Saturated
Input Voltage		90		mVpp	Single Sideband, 1dB Gain Compression
Voltage Gain		6		dB	Single Sideband
I/Q Amplitude Balance		0.1		dB	
Quadrature Phase Error		<±1		°	
Carrier Suppression		25		dBc	Unadjusted. Carrier Suppression may be optimized further by adjusting the DC offset level between the A and B inputs.
Sideband Suppression		30		dBc	
Power Supply					
Voltage		2.7 to 6		V	Operating limits
Current		8		mA	V_{CC}=3.0V
	8	10	12	mA	V_{CC}=5.0V

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QUADRATURE DEMODULATORS

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Item Number 14: Microprocessor, PIC16C55

12.1 DC Characteristics: PIC16C54/55/56/57-RC, XT, 10, HS, LP (Commercial)

PIC16C54/55/56/57-RC, XT, 10, HS, LP (Commercial)			Standard Operating Conditions (unless otherwise specified) Operating Temperature 0°C ≤ TA ≤ +70°C for commercial				
Param No.	Symbol	Characteristic/Device	Min	Typ†	Max	Units	Conditions
D001	VDD	Supply Voltage					
		PIC16C5X-RC	3.0	—	6.25	V	
		PIC16C5X-XT	3.0	—	6.25	V	
		PIC16C5X-10	4.5	—	5.5	V	
		PIC16C5X-HS	4.5	—	5.5	V	
		PIC16C5X-LP	2.5	—	6.25	V	
D002	VDR	RAM Data Retention Voltage(1)		1.5*	—	V	Device in SLEEP mode
D003	VPOR	VDD Start Voltage to ensure Power-on Reset		VSS	—	V	See Section 5.1 for details on Power-on Reset
D004	SVDD	VDD Rise Rate to ensure Power-on Reset	0.05*	—	—	V/ms	See Section 5.1 for details on Power-on Reset
D010	IDD	Supply Current(2)					
		PIC16C5X-RC(3)	—	1.8	3.3	mA	FOSC = 4 MHz, VDD = 5.5V
		PIC16C5X-XT	—	1.8	3.3	mA	FOSC = 4 MHz, VDD = 5.5V
		PIC16C5X-10	—	4.8	10	mA	FOSC = 10 MHz, VDD = 5.5V
		PIC16C5X-HS	—	4.8	10	mA	FOSC = 10 MHz, VDD = 5.5V
		PIC16C5X-HS	—	9.0	20	mA	FOSC = 20 MHz, VDD = 5.5V
		PIC16C5X-LP	—	15	32	µA	FOSC = 32 kHz, VDD = 3.0V, WDT disabled
D020	IPD	Power-down Current(2)	—	4.0	12	µA	VDD = 3.0V, WDT enabled
			—	0.6	9	µA	VDD = 3.0V, WDT disabled

* These parameters are characterized but not tested.

† Data in "Typ" column is based on characterization results at 25°C. This data is for design guidance only and is not tested.

Note 1: This is the limit to which VDD can be lowered in SLEEP mode without losing RAM data.

2: The supply current is mainly a function of the operating voltage and frequency. Other factors such as bus loading, oscillator type, bus rate, internal code execution pattern and temperature also have an impact on the current consumption.

a) The test conditions for all IDD measurements in active Operation mode are: OSC1 = external square wave, from rail-to-rail; all I/O pins tristated, pulled to VSS, T0CKI = VDD, $\overline{MCLR}$ = VDD; WDT enabled/disabled as specified.

b) For standby current measurements, the conditions are the same, except that the device is in SLEEP mode. The power-down current in SLEEP mode does not depend on the oscillator type.

3: Does not include current through Rext. The current through the resistor can be estimated by the formula: IR = VDD/2Rext (mA) with Rext in kΩ.

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Item Number 15: DSSS Transmitter, CYLINK SSTX

NO DATASHEET

US Patent Number:5,946,343 Issued to Schotz

Item Number 16: DSSS Receiver, CYLINK Part# SPECTRE

NO DATASHEET

US Patent Number:5,946,343 Issued to Schotz

Item Number 17: Mixer, IAM81008

NO DATASHEET

US Patent Number:5,946,343 Issued to Schotz

Item Number 18: Channel Encoder/Decoder, SRT241203

NO DATASHEET

US Patent Number:5,946,343 Issued to Schotz

Item Number 19: Interleaver/De-interleaver, SRT-24INT

NO DATASHEET

US Patent Number:5,946,343 Issued to Schotz

Item Number 20: Optical Digital Receiver, HK-3131-01

NO DATASHEET

US Patent Number:5,946,343 Issued to Schotz

Item Number 21: Optical Digital Transmitter, HK-3131-03

NO DATASHEET

US Patent Number:5,946,343 Issued to Schotz

Item Number 22: Voltage Controlled Oscillator, M2 D300

NO DATASHEET

EXHIBIT C

NOTE : A=Altstatt S=Schotz FHSS=Frequency Hopping Spread Spectrum w=with Tx=transmitter

System	Part	SupplyCurrent (in mA)	Size (in inches)	Playtime	Note
					Altstatt's Tx
A(Tx)	BA1404	3	18-pin 0.44 x 0.30		FM Stereo Transmitter
				16+ hours	Tx continuous operation time
S(Tx w SS)	DSP56002	90	144-pin 0.78 x 0.78		Schotz FHSS Tx
	>PLL	1	N/A		PLL located inside DSP56002
	>ckout	14	N/A		ckout located inside DSP56002
	SAA7360		44-pin 0.50 x 0.50		A/D converter
	>analog	43			function of the A/D converter
	>digital	50			function of the A/D converter
	SAA2520	82	44-pin 0.55 x 0.55		Stereo Filter MPEG
	SAA2521	25	44-pin 0.55 x 0.55		MPEG
	RF2422	45	16-pin 0.39 x 0.24		Modulator
	TQ9132	85	8-pin 0.19 x 0.23		Power Amp
	MC12210	10.2	16-pin 0.39 x 0.24		PLL
	SMV2500	19	12-pin 0.28 x 0.28		VCO
	HK-3131-01	no data	no data		**Optical Digital Rcvr (*)**
	M2 D300	no data	no data		**VCO (*)**
	SRT241203	no data	no data		**FEC (*)**
	SRT-24INT	no data	no data		**Interleaver (*)**
				0.1 hours or 6+ minutes	
A(Tx) equation in hours:					
{(60x50mA-minutes)/[(60 minutes/hour x 24 hour/day)(3mA)]} x (24hour/day) = 16.6 hours					
S(Tx w SS) equation in hours:					
{(60x50mA-min.)/[(60 min./hrx24 hr/day)(90+1+14+43+50+82+25+45+85+10.2+19mA)]}x(24hr/day)=6.4min					
where min = minutes and hr = hours					
(*) = Unable to locate datasheet for integrated chip (IC) referenced by Schotz					

NOTE : A=Altstatt S=Schotz FHSS=Frequency Hopping Spread Spectrum w=with Rx=Receiver

System	Part	SupplyCurrent (in mA)	Size (in inches)	Playtime	Note
					Altstatt's Rx
A(Rx)	TA7792	4	16-pin 0.77 x 0.30		AM/FM Tuner System
	TA7766A	0.8	18-pin 0.44 x 0.30		FM PLL
				10+ hours	Rx continuous operation time
S(Rx w SS)	DSP56002	90	144-pin 0.78 x 0.78		Schotz FHSS Rx
	>PLL	1	N/A		PLL located inside DSP56002
	>ckout	14	N/A		ckout located inside DSP56002
	MGA86576	16	4-pin 0.20 x 0.07		LNA
	HK-3131-03	no data	no data		**Optical Digital Tx (*)**
	CS8402	1.5	28-pin 1.20 x 0.20		Digital Interface Tx
	SAA2520	82	44-pin 0.55 x 0.55		Stereo Filter MPEG
	TDA1305T	42	28-pin 0.70 x 0.40		DAC
	TRU-050	63	16-pin 0.80 x 0.30		Clock Recovery and Timing
	RF2703	10	14-pin 0.34 x 0.24		Demodulator
	MC12210	10.2	16-pin 0.39 x 0.24		PLL
	SMV2500	19	12-pin 0.28 x 0.28		VCO
	SRT241203	no data	no data		**FEC (*)**
	SRT-24INT	no data	no data		**De-interleaver (*)**
	IAM81008	no data	no data		**Mixer (*)**
				0.14 hours or 8+ minutes	
A(Rx) equation in hours:					
{(60x50mA-minutes)/[(60 minutes/hour x 24 hour/day)(4.8mA)]} x (24hour/day)					
S(Rx w SS) equation in hours:					
{(60x50mA-minutes)/[(60 minutes/hour x 24 hour/day)(sum of IC currents in mA)]} x (24hour/day)					
(*) = Unable to locate datasheet for integrated chip (IC) referenced by Schotz					

NOTE : A=Altstatt S=Schotz DSSS=Direct Sequence Spread Spectrum w=with Tx=transmitter

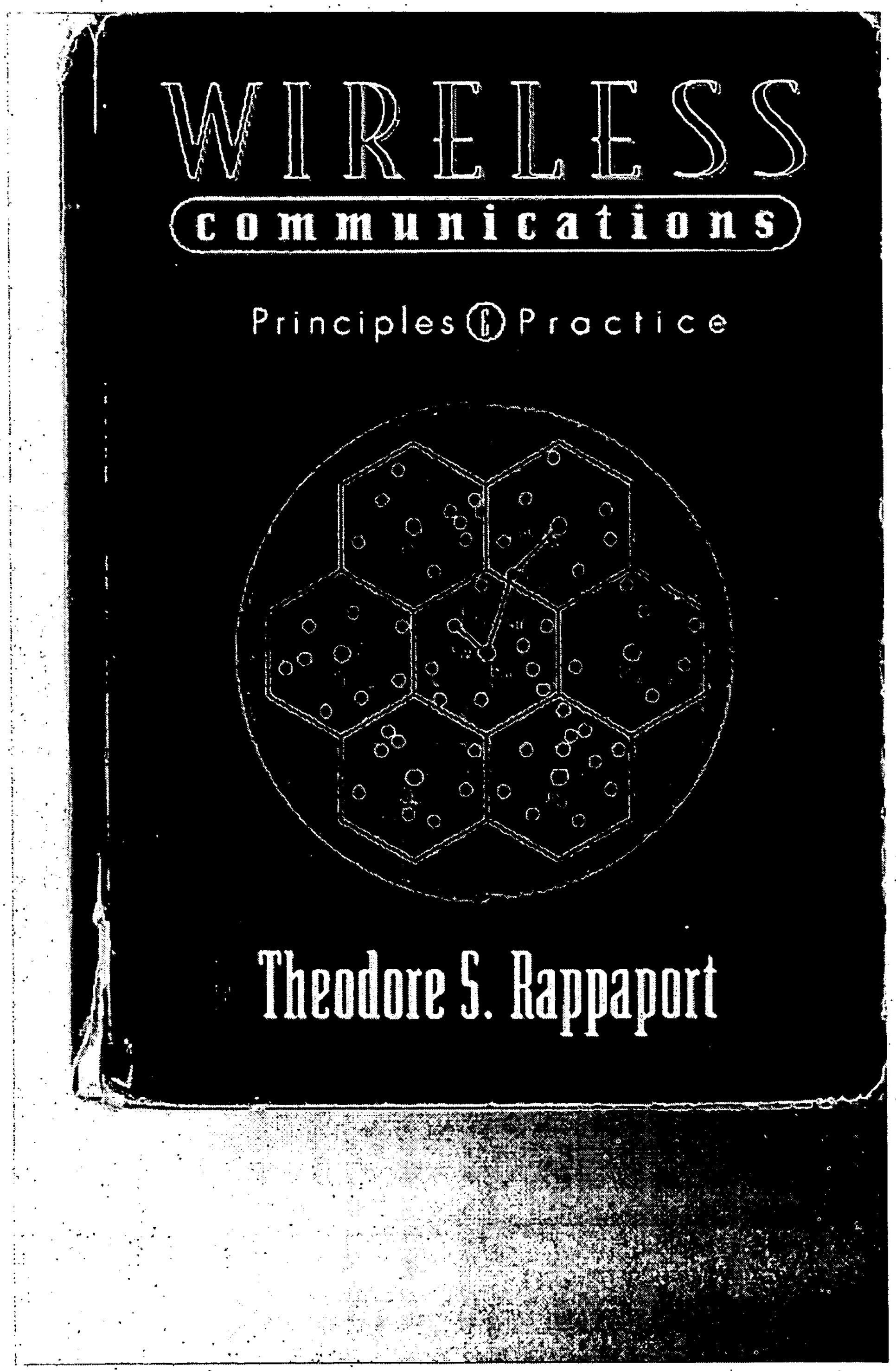
System	Part	SupplyCurrent (in mA)	Size (in inches)	Playtime	Note
					Altstatt's Tx
A(Tx)	BA1404	3	18-pin 0.44 x 0.30		FM Stereo Transmitter
				16+ hours	Tx continuous operation time
S(Tx w SS)	DSP56002	90	144-pin 0.78 x 0.78		Schotz DSSS Tx
	>PLL	1	N/A		PLL located inside DSP56002
	>ckout	14	N/A		ckout located inside DSP56002
	PIC16C55	1.8	28-pin 1.5 x 0.50		Microprocessor
	SAA7360		44-pin 0.50 x 0.50		A/D converter
	>analog	43			function of the A/D converter
	>digital	50			function of the A/D converter
	RF2422	45	16-pin 0.39 x 0.24		Modulator
	MC12210	10.2	16-pin 0.39 x 0.24		PLL
	SMV2500	19	12-pin 0.28 x 0.28		VCO
	CYLINK SSTS	no data	no data		**DSSS Transmitter (*)**
	HK-3131-01	no data	no data		**Optical Digital Rcvr (*)**
	M2 D300	no data	no data		**VCO (*)**
				0.18 hours or 11 minutes	
A(Tx) equation in hours:					
{(60x50mA-minutes)/[(60 minutes/hour x 24 hour/day)(3mA)]} x (24hour/day)					
S(Tx w SS) equation in hours:					
{(60x50mA-minutes)/[(60 minutes/hour x 24 hour/day)(sum of IC currents in mA)]} x (24hour/day)					
(*) = Unable to locate datasheet for integrated chip (IC) referenced by Schotz					

NOTE : A=Altstatt S=Schotz DSSS=Direct Sequence Spread Spectrum w=with Rx=Receiver

System	Part	SupplyCurrent (in mA)	Size (in inches)	Playtime	Note
					Altstatt's Rx
A(Rx)	TA7792	4	16-pin 0.77 x 0.30		AM/FM Tuner System
	TA7766A	0.8	18-pin 0.44 x 0.30		FM PLL
				10+ hours	Rx continuous operation time
S(Rx w SS)	DSP56002	90	144-pin 0.78 x 0.78		Schotz DSSS Rx
	>PLL	1	N/A		PLL located inside DSP56002
	>ckout	14	N/A		ckout located inside DSP56002
	PIC16C55	1.8	28-pin 1.5 x 0.50		Microprocessor
	CYLINK	no data	no data		DSSS Receiver
	MGA86576	16	4-pin 0.20 x 0.07		LNA
	IAM81008	no data	no data		**Mixer (*)**
	CS8402	1.5	28-pin 1.20 x 0.20		Digital Interface Tx
	TDA1305T	42	28-pin 0.70 x 0.40		DAC
	MC12210	10.2	16-pin 0.39 x 0.24		PLL
	SMV2500	19	12-pin 0.28 x 0.28		VCO
	HK-3131-03	no data	no data		**Optical Digital Tx (*)**
				0.25 hours or 15 minutes	

A(Rx) equation in hours:					
{(60x50mA-minutes)/[(60 minutes/hour x 24 hour/day)(4.8mA)]} x (24hour/day)					
S(Rx w SS) equation in hours:					
{(60x50mA-minutes)/[(60 minutes/hour x 24 hour/day)(sum of IC currents in mA)]} x (24hour/day)					
(*) = Unable to locate datasheet for integrated chip (IC) referenced by Schotz					

EXHIBIT D


WIRELESS
communications
Principles & Practice
Theodore S. Rappaport

microcellular systems. However, satellite mobile systems offer tremendous promise for paging, data collection, and emergency communications, as well as for global roaming before IMT-2000 is deployed. In early 1990, the aerospace industry demonstrated the first successful launch of a small satellite on a rocket from a jet aircraft. This launch technique is more than an order of magnitude less expensive than conventional ground-based launches and can be deployed quickly, suggesting that a network of LEOs could be rapidly deployed for wireless communications around the globe. Already, several companies have proposed systems and service concepts for worldwide paging, cellular telephone, and emergency navigation and notification [IEE91].

In emerging nations, where existing telephone service is almost nonexistent, fixed cellular telephone systems are being installed at a rapid rate. This is due to the fact that developing nations are finding it is quicker and more affordable to install cellular telephone systems for fixed home use, rather than install wires in neighborhoods which have not yet received telephone connections to the PSTN.

The world is now in the early stages of a major telecommunications revolution that will provide ubiquitous communication access to citizens, wherever they are [Kuc91], [Goo91], [ITU94]. This new field requires engineers who can design and develop new wireless systems, make meaningful comparisons of competing systems, and understand the engineering trade-offs that must be made in any system. Such understanding can only be achieved by mastering the fundamental technical concepts of wireless personal communications. These concepts are the subject of the remaining chapters of this text.

1.6 Problems

1.1 Why do paging systems need to provide low data rates? How does a low data rate lead to better coverage?

1.2 Qualitatively describe how the power supply requirements differ between mobile and portable cellular phones, as well as the difference between pocket pagers and cordless phones. How does coverage range impact battery life in a mobile radio system?

1.3 In simulcasting paging systems, there usually is one dominant signal arriving at the paging receiver. In most, but not all cases, the dominant signal arrives from the transmitter closest to the paging receiver. Explain how the FM capture effect could help reception of the paging receiver. Could the FM capture effect help cellular radio systems? Explain how.

1.4 Where would walkie-talkies fit in Tables 1.5 and 1.6? Carefully describe the similarities and differences between walkie-talkies and cordless telephones. Why would consumers expect a much higher grade of service for a cordless telephone system?

1.5 Assume a 1 Amp-hour battery is used on a cellular telephone (often called a cellular subscriber unit). Also assume that the phone's radio receiver draws 35 mA on receive and 250 mA during a call. How long would the phone work (i.e. what is the battery life) if the user has one 3-minute call every day? every 6

hours? every hour? What is the maximum talk time available on the cellular phone in this example?

1.6 Assume a CT2 subscriber unit has the same size battery as the phone in Problem 1.5, but the paging receiver draws 5 mA and the transmitter draws 80 mA during a call. Recompute the battery life for the cases in Problem 1.5. Recompute the maximum talk time for the CT2 handset.

1.7 Why would one expect the CT2 handset in Problem 1.6 to have a smaller battery drain during transmission than a cellular telephone?

1.8 Why is FM, rather than AM, used in most mobile radio systems today? List as many reasons as you can think of, and justify your responses. Consider issues such as fidelity, power consumption, and noise.

1.9 List the factors that led to the development of (a) the GSM system for Europe, and (b) the U.S. digital cellular system. How important was it for both efforts to (i) maintain compatibility with existing cellular phones? (ii) obtain spectral efficiency? (iii) obtain new radio spectrum?

1.10 Assume that a GSM, an IS-95, and a U.S. digital cellular base station transmit the same power over the same distance. Which system will provide the best SNR at a mobile receiver? How much is the improvement over the other two systems? Assume a perfect receiver with only thermal noise is used for each of the three systems.

1.11 Discuss the similarities and difference between a conventional cellular radio system and a space-based cellular radio system. What are the advantages and disadvantages of each system? Which system could support a larger number of users for a given frequency allocation? How would this impact the cost of service for each subscriber?

1.12 Assume that wireless communication services can be classified as belonging to one of the following four groups:

High power, wide area systems (cellular)
Low power, local area systems (cordless telephone and PCS)
Low speed, wide area systems (mobile data)
High speed, local area systems (wireless LANs)

Classify each of the wireless systems described in Chapter 1 using these four groups. Justify your answers. Note that some systems may fit into more than one group.

1.13 Discuss the importance of regional and international standards organizations such as ITU-R, ETSI, and WARC. What competitive advantages are there in using different wireless standards in different parts of the world? What disadvantages arise when different standards and different frequencies are used in different parts of the world?

1.14 Based on the proliferation of wireless standards throughout the world, discuss how likely it is for IMT-2000 to be adopted. Provide a detailed explanation, along with probable scenarios of services, spectrum allocations, and cost.

Solutions Manual to Accompany

Wireless Communications
Principles and Practices

FIRST EDITION

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Con't'd

infrastructure, complexity, hardware cost are all low.

A cordless telephone, on the other hand, is a full duplex system. It allows simultaneous two-way communication. Transmission and reception is on two different channels (FDD) although new cordless system are using TDD. The coverage range, required infrastructure, hardware cost of a cordless phone system are low and the complexity is moderate. User expectations are greater for a cordless telephone.

1.5 If the user has one 3-minute call every day

the battery life $= \dfrac{60\times1000\ (\text{mA-minute})}{(60\times24-3)\times35+3\times250\ (\text{mA-minute})}$

$\doteq 1.175$ days $\doteq \underline{\underline{28.2 \text{ hours}}}$

If the user has one 3-minute call every 6 hours

the battery life $= \dfrac{60\times1000}{((60\times6-3)\times35+3\times250} \times 6 \doteq \underline{\underline{27.18 \text{ hours}}}$

If the user has one 3-minute call every hour.

the battery life $= \dfrac{60\times1000}{(60-3)\times35+3\times250} \doteq \underline{\underline{21.86 \text{ hours}}}$

The maximum talk time $= \dfrac{60\times1000}{250} = 240$ minutes $= \underline{\underline{4 \text{ hours}}}$

1.6 For 3-minute call/day

battery life $= \dfrac{60\times1000\ (\text{mA-minute})}{(60\times24-3)\times5+3\times80} \doteq 8.08$ days $= \underline{\underline{193.94 \text{ hours}}}$

1.6 Con't'd

For 3 minute-call/6 hours.

battery life $= \dfrac{60\times1000}{(60\times6-3)\times5+3\times80} \times 6 \doteq \underline{\underline{177.78 \text{ hours}}}$

For 3 minute-call/hour.

battery life $= \dfrac{60\times1000}{(60-3)\times5+3\times80} \doteq \underline{\underline{114.29 \text{ hours}}}$

The maximum talk time $= \dfrac{60\times1000}{80} \doteq 750$ minutes $= \underline{\underline{12.5 \text{ hours}}}$

1.7 Since the coverage range of the CT-2 system is lower than that of the cellular radio system, to obtain the same signal-to-noise ratio in the coverage area, a CT-2 handset requires less transmitted power than a cellular telephone, and thus a smaller battery drain.

1.8 FM has several advantages over AM. The most important advantage is FM's superior noise suppression characteristics. With conventional AM, the modulating signal is impressed onto the carrier in the form of amplitude variations. However, noise introduced into the system also produces changes in the amplitude of the envelope. Therefore, the noise cannot be removed from the composite waveform without also removing a portion of the information signal. With FM, the information is impressed onto the carrier in the form of frequency variations. Therefore, with FM receivers,